

Condition Monitoring



With reliability and availability becoming increasingly crucial to railway operators, the use of computer based condition monitoring techniques are being applied to points machines, level crossing equipment and electric and pneumatic train door operator systems. Various techniques for recognising incipient failures are used, including neural network learning schemes.

About the research theme

The Condition Monitoring group specialises in developing bespoke instrumentation and processing systems that can be used to measure, track and predict the health of various railway subsystems. Such systems improve the operational reliability of the railway, or support business cases for variations in existing maintenance procedures. The group operates over a number of Technology Readiness Levels, producing systems to support fundamental understanding of a railway subsystem, up to working with companies to develop research into commercial products or applications.

The group has worked with major organisations such as Train Operating Companies (e.g. Merseyrail and Southern) and Infrastructure Managers (e.g. Network Rail and London Underground) and has been awarded the Stephenson award for Engineering Innovation at the National Rail Awards for work using in-service instrumentation to target maintenance on the 3rd rail network. Algorithms developed at Birmingham are also used within Network Rail's *Intelligent Infrastructure* programme, which continuously monitors the health of over 5000 sets of points.

Current major projects

Acoustic Axle Bearing Condition Monitoring

In association with Hitachi, this project develops acoustic condition monitoring systems to detect and characterise faulty axle bearings from the wayside.

Automatic switch inspection

Development of automatic, laser-based inspection system for use in switches and crossings.

Characterisation of sub-surface cracks

In association with TSC, this project investigates sub-surface, but surface breaking, cracks using data recorded from surface wave electromagnetic measurements.

Void detection and characterisation (EIT/Wessex Alliance)

Development of a vehicle-borne, in-service void detection system, based on inertial sensor measurement technology. Supported by low-cost trackside void characterisation systems, powered from energy harvesting sources.

Points performance projects

Environmental effects (Thales) to evaluate points machine performance under varying environmental conditions, in order to include seasonal variation tolerances.

EPCM (Network Rail) to extend the work previously undertaken by the group to develop points machine condition monitoring algorithms for Network Rail.

Points Condition Monitoring Architectures (Guangzhou Metro) to develop and evaluate alternative points condition monitoring architectures and processing substrates for use in metro environments.

HiTechRail demonstrator projects

Within a wide-reaching ERDF-funded technology transfer project for the West Midlands SME community:

Freight shuffling

Development of a demonstrator for RailFast, to be used to minimise unloading dwell times by reconfiguring freight during transit.

Pneumatic points machine testing

FMECA (Failure modes, effects and criticality analysis); life cycle testing; performance testing of a new design of points machine for Track Systems UK.

Knowledge Transfer Partnership (Arrowvale)

Development of low cost energy harvesting data logger for use in trackside monitoring.

Condition monitoring signalling power supplies

Working with EIT/Wessex Alliance this project aims to develop a system to monitor the condition of the power supply network for railway signalling systems.

Track Circuit Condition Monitoring projects

EIT/Wessex Alliance: to develop a low-cost TCCM system.

RSSB:to develop a system for Mainline audio-frequency track circuits.

London Underground Ltd:to develop a system for Metro-type audio-frequency track circuits.

Pantograph dynamic load test rig (FutureRailway)

Development of laboratory and depot-based test facility for evaluating and characterising pantograph dynamic loading (vertical) performance.

RiFlex

This EU FP7 project is for "Rail inspection by flexible electromagnetic acoustic transducer". Development of flexible electromagnetic acoustic transducers (EMATS) that are formed with electromagnetic coils embedded in a polyimide film and backed with permanent magnets.

Robotic inspection

Development of a robotic inspection cell for use with railway vehicle wheelsets.

Track 21 (EPSRC)

This EPSRC project investigates condition monitoring of track over transition zones such as switches and crossings, and transitions onto and off of hard structures.

TRIME in association with Southern Railway

A third rail geometry condition monitoring system running on an in-service class 377 vehicle.

Underframe visual inspection in association with LUL and Qinetiq

The use of visual inspection technologies to optimise and improve vehicle under-frame maintenance procedures.

WiRailCom (EU FP7)

Development of a standard wireless communications framework and interface for use with intelligent, self-contained, sensors nodes powered by energy harvesting technologies.

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